Supply Device

The present invention relates to a supply device for the supply of pressure fluid into at least one vehicle brake, into a pressure fluid reservoir or into a pressure fluid accumulator, with a pressure fluid inlet and a pressure fluid outlet as well as a piston, which is movably arranged in an accommodating member and has at least two hydraulically active diameters for the supply in the direction of the pressure fluid outlet, wherein at least one non-return valve is used for the ventilation of a working chamber into which the piston is immersed.

A supply device of the type of a stepped-piston pump is principally known in the art and illustrated in Figure 1. An object of the invention is to provide a supply device that is wear-resistant and improved in terms of manufacturing costs and mounting space requirement.

This object is achieved because the piston has a multi-part design and comprises at least two synchronously movable partial pistons, with the first partial piston exhibiting the first hydraulically active diameter, and the second partial piston exhibiting the second hydraulically active diameter. This type of construction allows reducing the demands placed on the concentricity of the bore (pump bore) in the accommodating member. A higher rate of flexibility is possible with respect to the variation of the type of construction of partial pistons and non-return valves. The result is that different embodiments of partial pistons and non-return valves

can be combined in a modular system with little expenditure. Transverse forces at the piston and, hence, piston wear is reduced due to the mechanical decoupling of the areas with different diameters.

For a further reduction in costs, the invention allows the use of finished rolling bearing needles in the capacity of a first partial piston. The second partial piston is preferably provided as a metal worked part shaped in chipless forming or as a molded plastic part. Even if the second partial piston is designed as a turned part, the manufacturing extent at the plant of the manufacturer of the supply device is reduced due to reduced machining operations.

The number of the necessary components is reduced in another embodiment of the invention when the first partial piston and the second partial piston are arranged and guided so as to be movable directly in the accommodating member.

To reduce the leakage, it is advantageous according to an embodiment of the invention when a sealing element is associated in each case with the first and the second partial piston for sealing the working chamber.

It is particularly favorable when the second partial piston includes a sealing seat for a valve member of the non-return valve. The mounting space requirement is reduced especially in the axial direction when the non-return valve is integrated into the second partial piston.

If the accommodating member is made of a material of low wear resistance, and in order to guide the second piston part quasi in a type of bushing, the non-return valve can be configured

as a suction valve. There is provision of another non-return valve designed as a pressure valve and having a sealing seat provided at a base member that includes a casing in which the second partial piston is received.

When the surface of the casing has a stop at its end, said stop can be used to secure the sealing element in an accommodating bore of the accommodating member.

Low-cost manufacture is additionally achieved when the second partial piston is designed as a ball and when the ball is arranged and guided in a casing of a base member for a non-return valve. For reducing the manufacturing extent, the ball can be a purchased rolling bearing ball.

The effort and structure needed for manufacturing the non-return valve is reduced when it is designed integrally as a sleeve-type non-return valve.

The invention will be explained in the following by way of the accompanying drawings showing an enlarged view in each case.

Figure 1 is a cross-sectional view of a prior art supply device.

Figure 2 is a cross-sectional view of a first embodiment of the invention.

Figure 3 is a cross-sectional view of a second embodiment of the invention.

Figure 4 is a cross-sectional view of a third embodiment of the invention.

Figure 5 is a cross-sectional view of a fourth embodiment of the invention.

Figure 1 shows a supply device 1 having a one-part piston 2 that is arranged and guided so as to be movable in a bore 3 of an accommodating member 4, which latter is a component of an electrohydraulic assembly equipped with an electronic control unit (ECU) for use in a motor vehicle brake system in particular. The accommodating member 4 includes non-illustrated, electromagnetically actuatable valves and channels interconnecting the valves and allowing the supply of pressure fluid out of a schematically sketched inlet (E) to an outlet (A), more specifically, from a working chamber 11 into a non-illustrated pressure fluid accumulator or into non-illustrated vehicle brakes or a pressure fluid reservoir, respectively, for the purpose of a controlled pressure increase. This arrangement enables braking of the vehicle or a control intervention such as a driving stability control intervention (ESP) or any other control intervention such as slip control in particular.

In order to improve the filling ratio in the working chamber 11, the pump has a pre-charging mechanism because the piston 2 has a stepped design and disposes of two separable, differently large hydraulically active diameters D1, D2. The smaller hydraulic diameter D1 along with a supply chamber 25 provided in the accommodating member 4 causes a charging effect for the working chamber 11 because the pressure fluid volume available in the supply chamber 25 eliminates the effect of restricted suction as occurring in simple piston pumps without steps. The piston 2 with one end abuts indirectly by way of a roller bearing on a driving eccentric,

which is set rotating by means of a shaft of an electric motor not shown. A resetting spring 5 is inserted between a carrier 6 for a non-return valve 12 and the piston 2 and ensures a permanently active resetting force.

As can be taken from Figure 1, a non-return valve 7 configured as a suction valve is provided between supply chamber 25 and working chamber 11. Further, a non-return valve 12 configured as a pressure valve is used for the ventilation of the working chamber 11. For this purpose, a valve member 8 of the non-return valve 7 is pressed by a spring 9 to permanently adopt a closing position for abutment on a piston-side sealing seat 10. Only during a suction stroke of the piston 2 will the pressure difference applied to the valve member 8 overcome the active spring force so that the valve member 8 moves into the non-illustrated opening position for the ventilation of the working chamber 11, with the result that the inlet of pressure fluid into the working chamber 11 takes place. The pressure fluid inlet is closed during the pressure stroke, and the pressure fluid propagates to the mentioned consumer through the non-return valve 12 that opens when subjected to pressure.

Referring to Figure 2, the differences will be dealt with in the following. Features corresponding to each other have been assigned like reference numerals. According to Figure 2, the piston 2 has a multi-part design and comprises a first and a second partial piston 13, 14 which are synchronously movable with each other, are in direct abutment on each other and have a channel 26 in their abutment surface which connects the supply chamber 25 and the working chamber 11. Both partial pistons 13, 14 are movably received directly in the bore 3 of the accommodating member 4, and sealing elements 15, 16 are used to seal the working chamber 11 and the supply chamber 25.

The first partial piston 13 comprises a rolling bearing needle that is preferably left in the condition at time of supply so that no machining, in particular no metal-cutting operation is required. The second partial piston 14 is preferably a non-cutting shaped metal worked part or a molded plastic part. As shown in Figure 2, the non-return valve 7 is integrated into the second piston part 14. Beside the non-return valve 7, another non-return valve 12, configured as a pressure valve, is provided in the supply direction and spaced axially from the partial piston 14, said non-return valve having a base member 17 and an integrated throttle bore 30 acting in the direction of outlet A.

The embodiment according to Figure 3 differs from Figure 2 because the other pressure valve 12 includes a base member 17 with a sealing seat 18 for an elastically biased closure member 19 and a casing 20, which accommodates the second partial piston 14 in its interior. Because the partial piston 14 abuts on an inside wall 21 of the casing 20, the latter is quasi used as a bushing for the second partial piston 14. When the base member 4 is made of a material of low wear resistance, this allows improving the wear resistance, provided a corresponding wearing quality of casing 20. Casing 20 includes at its end an integrally shaped stop 22 bent at right angles in a radially inward direction for securing the sealing element 15 in position in the bore 3 of the accommodating member 4.

Figure 4 differs from Figure 3 in that the sealing element 16 at the second partial piston 14 was omitted so that the partial piston 14 moves directly within the inside wall 21 of the casing 20. Further, the non-return valve 12 does not have a spring guide, which is in contrast to Figures 2 and 3. A

separate disc 23, which bears against a frontal end of casing 20, is used to secure the position of the sealing element 15.

Figure 5 displays an embodiment in which the second partial piston 24 is configured as a ball. Said ball is preferably a rolling bearing ball. The thus formed partial piston 24 moves, as is illustrated in Figure 4, directly on the inside wall 21 of the casing 20 that starts from the base member 17. A resetting spring 5 is provided and biased between the base member 17 and the ball. At the other, principally open end, the casing 20 is closed in such a fashion that the ball remains within the casing 20 so that a pre-assembled unit is composed of base member 17, resetting spring 5, and partial piston 24. In this embodiment of the invention, the non-return valve 27 (suction valve) is provided as an integral sleeve-type non-return valve whose (dynamic) sealing lip 28 that opens or closes in response to the differential pressure abuts on an outside wall 29 of the casing 20.

List of Reference Numerals:

1	supply device	E	inlet
2	piston	A	outlet
3	bore	D1	diameter
4	accommodating member	D2	diameter
5	resetting spring		
6	carrier		
7	non-return valve		
8	valve member		
9	spring		
10	sealing seat		
11	working chamber		
12	non-return valve		
13	partial piston		
14	partial piston		
15	sealing element		
16	sealing element		
17	base member		
18	sealing seat		
19	closure member		
20	periphery		
21	inside wall		
22	stop		
23	disc		
24	partial piston		
25	supply chamber		
26	channel		
27	non-return valve		
28	sealing lip		
29	outside wall		
30	throttle bore		